# FINAL PROJECT REPORT

## Title: Enhancement of Fundus Photography using MATLAB

## Course: Image Processing

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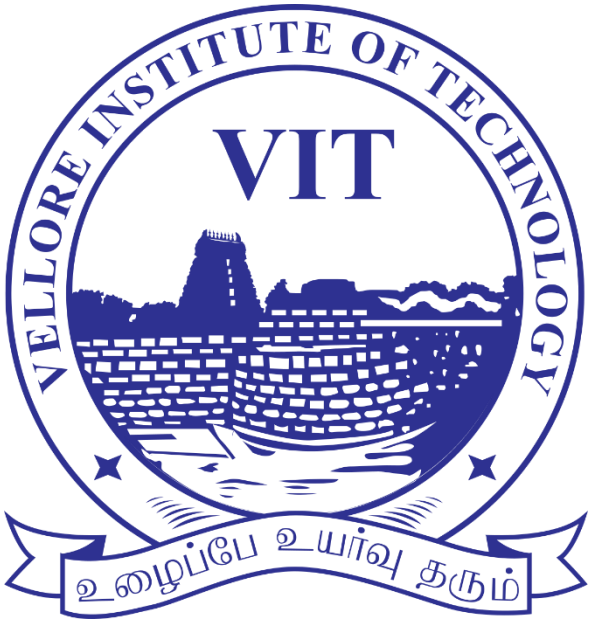


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# ABSTRACT

Medical digital imaging has become a key element of modern health care procedures. It provides visual documentation and a permanent record for the patients, and most important the ability to extract information about many diseases. Modern ophthalmology thrives and develops on the advances in digital imaging and computing power. In this work we present an overview of recent image processing techniques in the area of digital eye fundus photography.

Fundus photography involves capturing a photograph of the back of the eye i.e. Fundus-Specialized fundus cameras that consist of an intricate microscope attached to a flash enabled camera are used in fundus photography. The main structures that can be visualized on a fundus photo are the central and peripheral macula.Fundus photography can be performed with colored filters, or with specialized dyes.

Applications range from retinal image quality assessment to image restoration via blind deconvolution and visualization of structural changes in time between patient visits. All proposed within a framework for improving and assisting the medical practice and the forthcoming scenario of the information chain in telemedicine. Furthermore, advances in electronic media transmission increase the relevance of using image processing in 'teleophthalmology' as an aid in clinical decision-making, with particular relevance to large rural-based communities.

These diagnostic systems offer the potential to be used in large-scale screening programs, with the potential for significant resource savings, as well as being free from observer bias and fatigue. In addition, quantitative measurements of retinal vascular topography using digital image analysis from retinal photography have been used as research tools to better understand the relationship between the retinal microvasculature and cardiovascular disease.

## OBJECTIVES

- Assisting and improving medical practices mainly in the field of Ophthalmology
- Providing better medical services to rural and less roadconnected areas through Telemedicine/Teleophthalmology.
- Rid the diagnosis of observer bias and fatigue.
- Better understand the connections between retinal microvasculature and cardiovascular disease.

# INTRODUCTION

Image processing is the field of signal processing where both the input and output signals are images. Images can be thought of as two-dimensional signals via a matrix representation, and image processing can be understood as applying standard one-dimensional signal processing techniques to two-dimensional signals. Image processing is a very important subject, and finds applications in such fields as photography, satellite imaging, medical imaging, and image compression, just to name a few.

The retina is a layered tissue lining the interior of the eye that enables the conversion of incoming light into a neural signal that is suitable for further processing in the visual cortex of the brain. It is thus an extension of the brain. The ability to image the retina and develop techniques for analyzing the images is of great interest. As its function requires the retina to see the outside world, the involved ocular structures have to be optically transparent for image formation. Thus, with proper techniques, the retina is visible from the outside, making the retinal tissue, and thereby brain tissue, accessible for imaging noninvasively.

# MOTIVATION

The direction of progress, in the short and mid term in this field, is generally conceived within two scenarios:

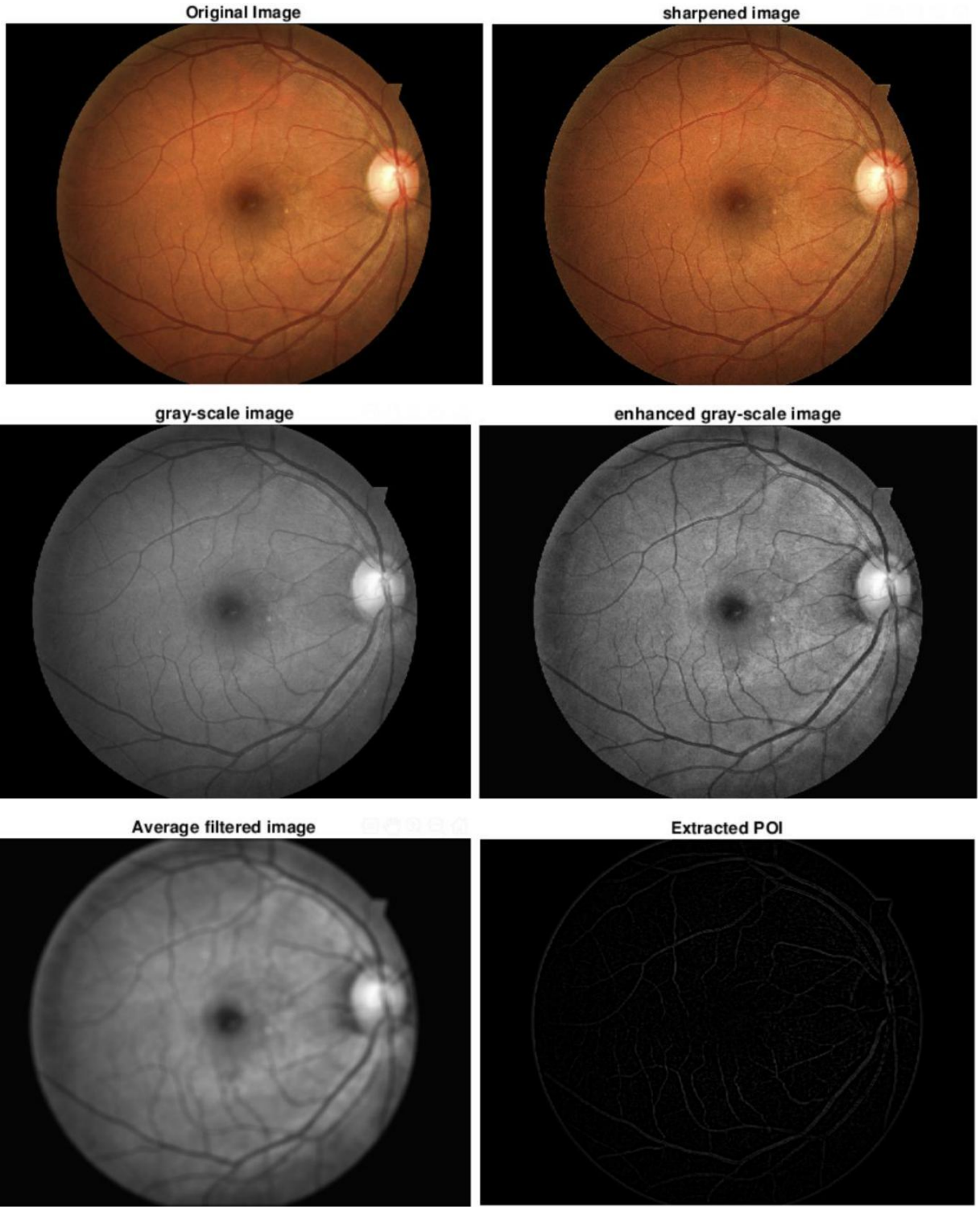
1) when the amount of data to be analyzed by the medical specialist is excessively large and
2) when the analysis is complex and requires quantification, as opposed to the more qualitative nature of the human expert.

Moreover, the aim of this study is to gain further knowledge about the composition of the tissues in the retina; the most popular area of interest in spectral imaging is probably ***retinal oximetry*.** The clear optical media in the eye gives clinicians a unique opportunity to obtain high quality images of the (micro)-vasculature of the retina and other pathologic structures using noninvasive imaging techniques.

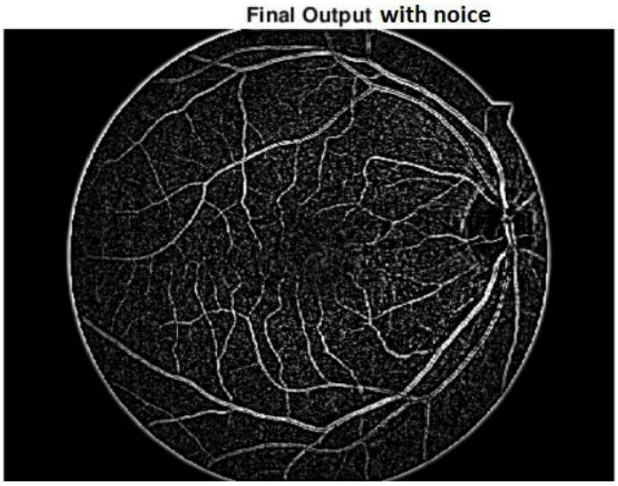
# PROCEDURE

- We seek to write a MATLAB code, which will read the input image and convert it into a matrix with arrays of pixel values.
- Then we apply a sharpening filter to that matrix.
- Then, we convert it to a Gray Level Image.
- We enhance the grayscale image using histogram equalization.
- Next, we will apply an average filter to extract abnormal spots and blood vessels from the gray image.
- Further, we use contrast enhancement to get a clearer image of the abnormal spots and blood vessels which will help the doctors in their diagnosis.

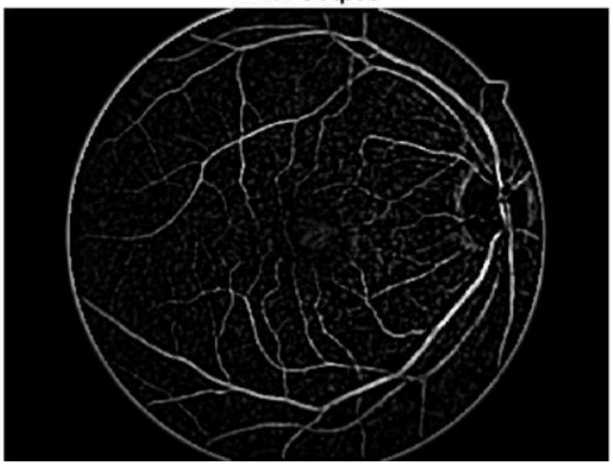
# OUTPUT


Original Image
sharpened image
gray-scale image
enhanced gray-scale image
Average filtered image
Extracted POI

Final Output with noice



Final Output



# CONCLUSION

As we have seen the application of digital image processing techniques for medical image analysis, in this case too, retinal images, is not only extremely beneficial but can also prove to be effective and cost-efficient for disease management, diagnosis, screening, etc. The increasing need for early detection and screening, along with the ever increasing costs of health care, are likely to be the driving force for the rapid adoption and translation of research findings into clinical practice, until recently, spectral retinal imaging has yielded to a trade-off between accurate spectral information in a large area of the retina and a high-resolution image of the retina as seen under a limited number of spectral bands.

# REFERENCES


1. de Mul, M., de Bont, A., and Berg, M. (2007). *IT-supported skill-mix change and standardization in integrated eye care: Lessons from two screening projects in The Netherlands*. International Journal of Integrated Care, 7(2).

2. Abramo, M. D., Garvin, M., and Sonka, M. (2010). *Retinal imaging and image analysis*. IEEE Reviews in Biomedical Engineering, 3, 169–208.

3. Saine, P., and Tyler, M. (2004). *Ophthalmic Photography: Retinal Photography, Angiography, and Electronic Imaging* (2nd ed.). Butterworth-Heinemann.

4. Bernardes, R., Serranho, P., and Lobo, C. (2011). *Digital ocular fundus imaging: A review*. Ophthalmologica, 226, 161–181.

5. Fujita, H., Uchiyama, Y., Nakagawa, T., Fukuoka, D., Hatanaka, Y., Hara, T., Lee, G., Hayashi, Y., Ikedo, Y., Gao, X., and Zhou, X. (2008). *Computer-aided diagnosis: The emergence of three CAD systems induced by Japanese health care needs*. Computer Methods and Programs in Biomedicine, 92(3), 238–248.

6. Bandara, A. M. R. R., and Giragama, P. W. G. R. M. P. B. (2017). *A retinal image enhancement technique for blood vessel segmentation algorithm*. In 2017 IEEE International Conference on Industrial and Information Systems (ICIIS), Peradeniya, Sri Lanka, pp. 1–5.